



Product Markets' Deregulation: A more Productive, more Efficient and more Resilient Economy?*

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Received: March, 2018

Accepted: July, 2018

Abstract

Relying on a rich firm-level dataset for one of the top product market reformers among OECD countries over the last decade, we find a positive association, already in the short-run, between firm-level productivity and deregulation of intermediate goods sectors. The long-run effects are mediated by firm-level productivity, with gains increasing with the distance to the (national) sectorial technological frontier. As laggard firms are more likely to be held-up by upstream producers with large market power, they have more to gain vis-à-vis more productive firms that are better equipped to deal with the inefficiencies of upstream markets. For the highly productive, the reduction of their competitive edge vis-à-vis low performers, coupled with decreased mark-ups and increased uncertainty, reduce their incentives to innovate. Importantly, we find evidence of positive selection among laggard companies: for viable firms, the reforms unlock their growth potential and allow them to catch-up; for non-viable laggards, the likelihood of exit increases as they are not able to compete in the more demanding environment. In fact, while the increased competition downstream (resulting from increased competition upstream) is associated with higher exit probabilities for all firms, we find a stronger association for low productivity firms. Finally, by comparing the performance of firms more and less exposed to pre-crisis reforms, we show that the survival of the fittest and the unlocking of viable laggards growth boosts the resilience of the firms operating in the market.

Keywords: Structural Reforms, Product Markets, Productivity.

JEL Classification: D04, D22, L43, L51

* The opinions expressed are those of the authors and not necessarily those of the institutions. Part of this research was conducted while the authors were at the Portuguese Ministry of Finance. The authors are thankful to two anonymous referees, Susana Peralta (Nova SBE), Giuseppe Nicoletti and Balázs Égert (OECD), José Carlos Pereira (GPEARI/Ministry of Finance), Miguel Lebre de Freitas and Paulo Côrte-Real (Nova SBE), the participants of the 2nd Lisbon Conference on Structural Reforms, held in Lisbon on 6 July 2017 (Portuguese Ministry of Finance / Nova School of Business and Economic), and the participants of the OECD Global Forum on Productivity workshop held in the UK on 14 Oct. 2016.

1. Introduction

While in most developed countries competition is already high in the final goods sectors, given the integration into world trade, there are still important regulatory barriers sheltering intermediate goods producers, such as telecommunications services or energy providers. Increased competition in these upstream markets is expected to foster firm entry, allow the best performing firms to grow and potentiate the exit of the least productive, not only in the deregulated sectors but also more broadly, given the vertical linkages with other sectors in the economy.

There are multiple channels for these indirect effects of upstream deregulation on downstream firms to materialize, operating both via the intensive and extensive margins (see, for instance, Bourlés *et al.*, 2013)¹. The lack of competition in the intermediate goods market translates into higher market-power of firms in those sectors vis-à-vis final goods producers. Upstream firms are thus able to extract a rent from downstream producers, reducing the incentive to invest and innovate downstream (as a smaller fraction of the gain will be appropriated by the firm incurring the cost of the investment). Moreover, a more stringent regulatory environment reduces entry upstream and therefore makes it more difficult for new final good producers to access intermediate goods suppliers, reducing competition also downstream. The reduced competition allows non-viable firms –that would otherwise be forced to exit– to remain in the market and thus leads to an inefficient allocation of resources. But increased upstream competition may also have detrimental effects on upstream innovation, impacting the quality of the inputs used downstream. Several studies focused on the liberalization of the electricity sector in different countries find that increased competition and uncertainty reduce spending on R&D, at least in the short-run, which in turn may have long-lasting consequences (Jamashb and Pollitt, 2011 and 2008; and Sanyal and Cohen, 2009).

Overall, the indirect effects are likely to be heterogeneous across firms, in particular in relation to firms' ex-ante productivity levels. Laggard firms are more prone to being held-up by upstream firms, have less ability to cope with upstream market power and are more dependent on the prevailing intermediate goods market conditions. Therefore, they may have more to gain with increased competition upstream.

At the same time, increased competition in intermediate markets is likely to trickle-down and boost competition downstream (e.g. as entry becomes more appealing with improved access to upstream suppliers). As modelled by Aghion *et al.* (2005), the impact of competition on productivity depends on the balance between changes in pre and post innovation rents. If the reduction in post-innovation rents is sufficiently large, then competition has a discouraging (or Schumpeterian) effect, curbing innovation. Conversely, if competition reduces pre-innovation rents by more than it reduces post-innovation rents, it increases the incremental returns from innovation and thus fosters investments that allow firms to escape competition. One could therefore argue that escape competition is more likely to occur for firms closer to the technological frontier, as they have more to gain ex-post by becoming leaders.

However, too much competition erodes the escape competition incentives, making it more likely for the discouraging effect to dominate. For instance, market uncertainty may induce leaders to engage in safer competitiveness boosting alternatives, in detriment of more disruptive, but also riskier, innovation strategies (e.g. incremental innovations with lower impact on productivity or cost reducing measures such as reducing wage costs, e.g. via relocation; Amable *et al.*, 2016). Also, it may reduce available funding, given the negative impact of competition on the value of firms' pledgeable assets, thereby acting as a drag on innovation (Petroopoulos, 2017).

Therefore, the role of productivity in mediating the indirect impact of deregulation upstream on downstream firms is an open empirical question. Some authors find evidence that the impact increases with productivity, therefore being more beneficial for the best performing firms (e.g. Bourlés *et al.*, 2013; Arnold *et al.*, 2008). Gutiérrez and Philippon (2017) show that competition indeed fosters investment by the leaders, discouraging laggards that are unable to compete with new entrants. But if the process leads to increased concentration ex-post, the relative investment by frontier firms is adversely impacted (Gutiérrez and Philippon, 2017). Nicoletti and Scarpetta (2003) and Conway *et al.* (2006) argue that deregulation is actually increasing with the distance to the frontier, as enhanced competition creates the incentives for laggards to catch-up. Amable *et al.* (2016) argues that the impact is negative for the highly productive, given the reduction in mark-ups. In the same vein, Autor *et al.* (2016) find a negative relation between competition and patent production.

Another open empirical question relates to the timing of the effects. While the long-term impact is crucial to ascertain the possible benefits of increased competition in intermediate goods markets, the short-run effects are essential for the political economy of the reform process and for the design of the reform packages (e.g. bundling, sequencing, the use of grandfathering rules or compensation mechanisms). For instance, if increased competition fosters the exit of a telecommunications incumbent, it may take time for the client firms to find a new supplier, with switching costs during the process. Moreover, the exit of the least productive firms may temporarily increase unemployment, reducing short-term aggregate demand. And agents' possible perception of increased income insecurity may increase precautionary savings, further reducing aggregate demand.

Existing empirical applications are not conclusive on the prevalence and relevance of these short-run costs, which are likely to depend on the structure and cyclical position of the different economies (e.g. Égert and Gal, 2016b; Bouis *et al.*, 2012; Dabla-Norris *et al.*, 2015 and Gal and Hijzen, 2016). Model based-simulations find that short-term costs are more likely for small open economies (Cacciatore *et al.*, 2015), for economies at the zero lower bound (Eggertsson *et al.*, 2013) and during downturns (IMF, 2016).

Overall, if one finds evidence that increased competition succeeds in promoting firm growth (intensive channel) and in fostering the survival of the fittest (extensive channel), it is also likely that it boost firms' ability to weather shocks. Existing literature supports this conjecture, providing evidence of increased resilience and reduced volatility (Cacciatori and

Fiori, 2016; Duval *et al.*, 2007; Ernst *et al.*, 2007; Pelkmans *et al.*, 2008). Portugal provides an interesting application to study those mechanisms, given the severity of the crisis that affected the country.

In this paper, we focus on the link between competition upstream and firm-level productivity downstream, building on the empirical models of Arnold *et al.* (2008) and Bourlés *et al.* (2010), which in turn are based on the theoretical contributions of Acemoglu *et al.* (2006) and Aghion and Howitt (2006). Making use of a novel indicator of regulatory impact developed by the OECD, our identifying assumption is that firms operating in sectors which use more intensively intermediate goods inputs are more affected by restrictions to competition in those sectors.

This contribution aims at providing empirical insights into two open questions in the literature. First, we assess whether the short-run costs of reforms were present for the Portuguese economy. Portugal is a rich case study given that it was a top product market reformer among OECD countries, particularly in a period where all the three factors described in the model-based literature as likely to induce short-term costs – economic crisis and zero lower bound, in the context of a small open economy – were at play. Second, we shed light on the role of firm-level productivity in mediating the impact of product market reforms, both at the intensive and extensive margins. Again, Portugal is particularly suited for the study of firm-level heterogeneous effects, given the availability of high-quality, yearly census data on all Portuguese firms, covering balance sheet and profit and loss data. Finally, by making use of a large crisis episode, we test whether the intensive and extensive margin results contribute to enhance firms' ability to weather adverse shocks.

We do find evidence of a positive association between upstream deregulation and productivity already in the short-run, even though most reforms were implemented during crisis years, where short-run costs are more likely. The long-term gains are increasing with the firms' distance to the sectorial technological frontier. This result may indicate that inefficient intermediate goods markets are particularly damaging for laggard firms or that the trickle-down effects on downstream competition provided the needed incentives for laggards to catch-up in order to remain in the market. For the highly productive (the 2% most productive within each sector) deregulation upstream is actually detrimental, which may be linked with the negative impact of reduced mark-ups and increased market uncertainty on the willingness to engage in riskier, disruptive innovation, in particular during periods of great economic uncertainty. Moreover, while we find that the trickle down effects of higher competition upstream on downstream competition are associated, as expected, with a higher exit probability for individual firms, we also show that the effect is stronger for the least productive, reducing market congestion.

The two results combined – the intensive and extensive margin channels – highlight the relevance of product market reforms in promoting a more efficient resource allocation, by a process of firm selection: the least productive firms that have scope to improve and catch-up with the frontier are able to remain in the market and grow closer to the frontier; but those that

do not have conditions to enhance their productivity and become more competitive are forced to leave. This virtuous process is likely to promote higher resilience, as larger and more productive companies are better prepared to deal with adverse shocks. Also, the reduced market power upstream makes it more difficult for upstream producers to pass-on the crisis induced costs to downstream producers. By comparing firms operating in sectors more and less exposed to pre-crisis reforms to other firms operating in less exposed sectors, we indeed provide evidence of a positive impact of more efficient intermediate goods markets on downstream firms' resilience, with a more limited damaging impact of the crisis on productivity.

The paper proceeds as follows: Section 2 provides an overview of the relevant literature; Section 3 presents the regulatory variables and the main reforms introduced in recent years; Section 4 described the firm-level data; Section 5 presents the analytical framework and the results; Finally, Section 6 concludes.

2. Literature Review

There is an extensive literature on the long-run aggregate benefits of promoting a healthy level of competition in product markets². Both model based simulations (e.g. IMF, 2016; Andrés *et al.*, 2014; Everaert and Schule, 2008; and Arpaia *et al.*, 2007) and applied econometric research (e.g. Arnold and Barbosa, 2015; Barnes *et al.*, 2013; Bouis and Duval, 2011; Bouis *et al.*, 2012; IMF, 2015; OECD, 2015) confirm the existence of aggregate productivity gains that result from the growth of viable incumbents and increased churn-rates (European Commission, 2005; Schiantarelli, 2005; Lanau and Topalova, 2016, Gal and Hijzen, 2016).

These effects are mediated by a number of country and sectorial specificities, such as the initial regulatory stance, reform complementarities or the degree of competitiveness in the downstream market (e.g. Égert and Gal, 2016b; Bouis *et al.*, 2012; Dabla-Norris *et al.*, 2015 and Gal and Hijzen, 2016)³. Firm-level specificities also play a determinant role. The differential impact across the firm-level productivity distribution is particularly relevant to shed light on the transmission mechanisms and on the aggregate impact of the reforms and it is an open empirical question.

Nicoletti and Scarpetta (2003) show that, in manufacturing, the gains are greater the further a given country is from the technology leader, via improved incentives and opportunities to catch-up with the frontier. Amable *et al.* (2016) argue that the effects may even turn negative for the highly productive, which face higher uncertainty and lower incentives to engage in disruptive innovation. Autor *et al.* (2016) also find a negative relation between competition and patent production.

On the contrary, Arnold *et al.* (2008) and Bourlés *et al.* (2013) show that regulation is particularly detrimental for firms closer to international best practices. Gutiérrez and Philip-

pon (2017) corroborate the positive impact of competition for leading firms, discouraging investment for the laggards. However, if, over time, this leads to increased market concentration via the growth of frontier firms, the relative investment of the best performing may be adversely impacted (Gutiérrez and Philippon, 2017).

On top of heterogeneity across firms, reforms may also have heterogeneous effects across time. Model based contributions show that long-term benefits may nevertheless entail short-term costs, particularly likely during downturns (IMF, 2016), for small open economies (Cacciatore *et al.*, 2015) and for economies at the zero lower bound (Eggertsson *et al.*, 2013).

The evidence on applied econometric literature corroborates that short-term gains are not granted. For instance, while Cacciatore and Fiore (2016) and Bouis *et al.* (2012) find evidence of short-term costs, Gal and Hijzen (2016) and Barone and Cingano (2011) show that product market reforms bring gains already in the short-run. Firm-level national studies, such as Forlani (2012) for France and Lanau and Topalova (2016) for Italy, also provide evidence of short-term gains. A number of authors (e.g. IMF, 2016; Adhikari *et al.*, 2016; and Dabla-Norris *et al.*, 2015) highlight the role of macroeconomic conditions, notably in the short-run, with downturns reducing the expected gains.

The studies discussed above evaluate the impact of product market reforms from two angles: their direct effect on the intermediate goods markets and their effects on the economy at large, via vertical integration. For instance, while Gal and Hijzen (2016) and Lanau and Topalova (2016) focus mainly on upstream effects, Barone and Cingano (2011), Forlani (2012) and Bourlés *et al.* (2013) study the impact of reforms on downstream industries. Our contribution fits into the second work-stream.

Overall, if reforms give rise to a more efficient “creative destruction” process, they are also expected to improve the economy’s shock resilience, a result corroborated by Duval *et al.* (2007). In the same vein, Ernst *et al.* (2007) conclude that product market reforms reduce consumption volatility in the economy and Pelkmans *et al.* (2008) stress their role in lubricating shock adjustments, price stickiness and inflation persistence. Finally, Cacciatori and Fiori (2016) show that business cycle fluctuations and economic volatility decrease with the implementation of product market reforms.

3. Product market regulation

In recent years, Portugal implemented a large number of structural policies aimed at increasing productivity, fostering a more efficient allocation of resources and improving resilience to shocks. Product market reforms were a key area, given the dimension of the pre-existing challenges and the expected payoffs⁴. Data from the OECD capturing the stringency of product market regulation shows that while in 2003 Portugal was among the least compe-

tition-friendly economies, it was also one of the top reformers in the decade that followed (Figure 1). In 2013 the country is, for the first time, below the OECD average.

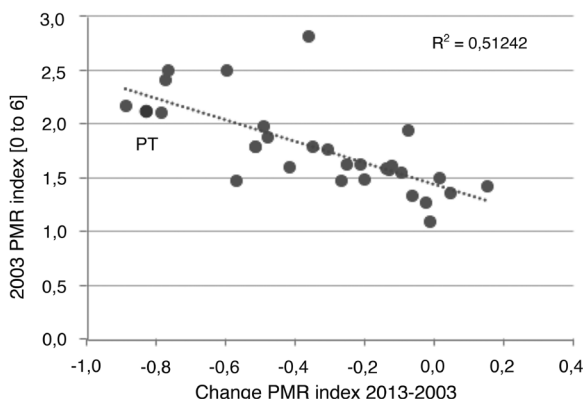


Figure 1: Product Market Regulation indicator

Source: OECD and authors own computations. Notes: The indicator increases with the stringency of regulation. Values below the trend line can be read as above average reform efforts, given the initial regulatory stance.

The product market reform agenda covered a large number of measures, aimed at fostering competition and reducing the excessive rents of sheltered sectors. The main measures implemented included the liberalization of gas and electricity markets, with the phasing out of regulated tariffs; negotiations with energy producers to reduce rents and eliminate the tariff debt; the creation of a transports regulator; the reduction of ports operating costs; new telecommunications regulatory framework, including the reduction of termination rates and lower restrictions on customers' mobility; a competition enhancing framework in the postal sector; several steps in the direction of the liberalisation of 19 regulated professions; the revision of the competition law and an improved enforcement (e.g. with the creation of specialized courts); and the elimination of State special rights in private companies.

Given that the reforms were broad-based, we rely on three OECD sub-indicators of sectorial product market regulation that allow us for a good depiction of the different reformed areas⁵. The first covers the regulatory environment on seven network sectors, namely telecoms, electricity, gas, post, rail, air passenger transport, and road freight. For each of them, the indicator takes into account, where applicable, entry regulations, public ownership, vertical integration, market structure and price controls.

The second focuses on regulated professions, namely accounting, legal, engineering and architectural services. For each, the indicator captures not only entry barriers (i.e. exclusive rights, education requirement, compulsory chamber membership and quotas) but also con-

duct regulations (i.e. quotas, prices and fees, marketing and advertising, form of business and inter-professional cooperation).

The third sub-indicator is a measure of regulation in retail distribution and covers registration and licensing, special regulation of large outlets, protection of existing firms, regulation of shop opening hours, price controls and, finally, promotions and discounts.

The focus of our analysis is the downstream impact of the described regulatory changes and therefore we need a measure of the exposure of the different downstream sectors to those upstream regulations. The resulting indicator of regulatory impact aims at measuring the potential costs of the anti-competitive regulation in network sectors, retail distribution and professional services on the different sectors of the economy that use the output of those regulated sectors as intermediate inputs:

$$RegImpact_{k,t} = \sum_{j=1}^n Regulation_{j,t} * w_{j,k}$$

The indicator is computed by the OECD for each of the 37 sectors of the economy (k). It weighs the degree of regulation in the different non-manufacturing sectors j in year t (*Regulation*) by the exposure (w) of sector k to the non-manufacturing sector j . Exposure is measured as the share of inputs from sector j on total inputs used in the production process of sector k , sourced from the OECD input-output matrices⁶. The intuition is that an electricity intensive sector is likely to be more affected by a liberalization of the electricity market than a sector less reliant on electricity as an input.

The final indicator (*RegImpact*) is normalized to [0,1], increasing in the regulatory impact, and it is available in two versions. We rely on the wide version, which includes network sectors, retail distribution and professional services as upstream sectors. It has decreased substantially in the past decade: for instance, the maximum regulatory exposure was 0.55 in 2004, 0.43 in 2008 and 0.36 in 2013 (Table A1 in the Appendix provides detailed data on the time evolution of the indicator for the different sectors). The narrow version, which only considers regulation in network sectors, is also tested for robustness purposes⁷.

4. Firm level data

Firm level data are sourced from the IES database - *Informação Empresarial Simplificada* (Simplified Corporate Information) provided by INE - *Instituto Nacional de Estatística* (Statistics Portugal). The IES was formally created by Decree-Law No 8/2007 of 17 January and the reporting within that framework is mandatory since 2007. Before IES, INE relied on survey data from *Inquérito Anual às Empresas*⁸. Broadly, IES is an electronically way to provide accounting, fiscal and statistical data in a single step, promoting transparency and efficiency in data transmission. It includes detailed information on income statements and

balance sheet data for all Portuguese firms, as reported simultaneously to the Ministry of Finance, the Ministry of Justice, Bank of Portugal and INE.

The initial dataset covers 3,916,315 firm-year observations for the period 2004-2014. To ensure consistency and robustness, we focus on firms with positive values of assets, turnover, external supplies and services and with non-negative personnel expenses and number of employees. In addition, using the 3-digit level NACE Rev. 3, we exclude specific sectors, namely financial activities and insurance services, health care, entertainment, domestic staff and international organizations, given the specificities of their business models. With these exclusions, we reach a dataset of 3,199,118 observations. Moreover, due to lack of underlying data, we are not able to compute total factor productivity (TFP) for around 300,000 observations, leaving us with a total of 2,892,449 observations.

The main performance variable is TFP, although we also compute Labour Productivity (LP) (output per worker), for robustness checks. TFP is computed using the Levinsohn and Petrin (2003) semi-parametric estimation method, which addresses the endogeneity problems arising from methods such as OLS or fixed-effects estimators that do not account for the correlation between input levels and productivity⁹.

Olley and Pakes (1996) proposed a consistent two-step estimator, with investment as a proxy the unobservable productivity term. Building on this method, Levinsohn and Petrin (2003) suggest the use of intermediate inputs as an alternative to investment, given that the former is likely to adjust more smoothly to productivity shocks (and investments are more often zeros in firms reported balance sheets, preventing the TFP computation).

The estimation departs from a Cobb-Douglas production function:

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t$$

Where y_t is the logarithm of the firm's output; l_t and m_t are variable inputs, namely the logarithm of labor and intermediate inputs, respectively; and k_t is the logarithm of the state variable capital. η_t is the error term that has two components: one correlated with the input (ω_t , the productivity component) and another uncorrelated with the input choices.

Demand for the intermediate input m_t depends on the firm's state variables k_t and ω_t :

$$m_t = m_t(k_t, \omega_t)$$

Under a mild assumptions, the demand function is monotonically increasing in ω_t and can thus be inverted, allowing for productivity to be written as a function of two observed variables.

$$\omega_t = \omega_t(k_t, m_t)$$

Finally, assuming that productivity is ruled by a first-order Markov process $w_t = E[w_t|w_{t-1}] + \xi_t$, where ξ_t is an innovation to productivity, uncorrelated with k_t but not necessarily with l_t , the production function can be re-written as:

$$y_t = \beta_l l_t + \varphi_t(k_t, m_t) + \eta_t$$

Where $\varphi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t(k_t, m_t)$.

Estimation proceeds in two stages: the first allows for the estimation of β_l , using a third-order polynomial approximation in k_t and m_t , whereas in the second stage one recovers the state variable coefficients¹⁰.

Instead of a two-step estimation, Woolridge (2009) proposes a more efficient GMM framework, taking into account the potential contemporaneous error correlation of the two stages of the original Levinsohn and Petrin approach (and, also, heteroskedasticity and serial correlation). Different applications (e.g Gal, 2013; Fontagné and Santoni, 2015; Mollisi and Rovigatti, 2017) show that coefficient estimates derived from the two methods are similar, with no significant impact in the results.

In our estimation, we defined inputs as follows: capital refers to fixed assets, labor to number of employees and intermediate inputs is proxied by external supplies and services. These entails a number of important limitations, as discussed for instance in Gal (2013). In particular, TFP differentials may capture differences in markups, labor quality, intangibles and capacity utilisation.

The technological frontier is defined as the firms in the 90th percentile for the estimated TFP, by year and sector, as in OECD (2016). The distance to the frontier (DTF) is computed for each firm as the difference between its TFP level and the TFP at the frontier, for each year and sector.

Sectorial fixed effects are constructed using the 3-digit level NACE Rev 3¹¹. Region fixed effects are obtained with the NUT 2 Portuguese regional division¹². Additionally, following the literature (e.g. OECD, 2014), firm size controls are included. In line with the Statistics Portugal methodology, each firm-size bracket is constructed according to the conditions presented in Table 1.

Table 1
FIRM SIZE - CRITERIA

Type of Firm	Number of Workers		Output
Micro	<10	and	<2 Million
Small	>10 and <50	and	>2 Million and <10 Million
Medium	>50 and <250	and	>10 Million and <50 Million
Large	>250	or	>50 Million

Source: Statistics Portugal.

Table 2 presents the descriptive statistics for the firm-level variables. The firms considered in the analysis have an average of 10 workers, 1.2 million € of output and 1.6 million € of assets. Concerning firm size, 82% are micro firms, 15% are small, 2% are medium and 0.4% are large. Operational costs and cost of employees account for, on average, 0.3 and 0.2 million €, respectively.

Frontier firms are, on average, larger than laggard firms in terms of output, assets and workers (Table 2). Top performing firms are not only more productive; the difference vis-à-vis laggards has been increasing over time (Figure 2), a pattern also visible for other OECD countries (Adalet McGowan *et al.*, 2017a; Andrews *et al.*, 2016). This warrants an assessment of possible heterogeneous effects across the productivity distribution. Moreover, Figure 3 shows TFP by firm status: incumbents, entrants and leavers. While up to 2008 the firms exiting the market have higher productivity than those entering, from 2009 onwards the pattern is reversed. It is therefore important to investigate the possible relation between these changing patterns and the enacted product market reforms.

Table 2
DESCRIPTIVE STATISTICS - FIRM LEVEL DATA

Variables	Unit	Mean	Std Dev	Min	Max	Mean frontier	Mean laggards
Output	10 ³ €	1,218	26,700	0	10,300,000	5,214	774
Operational Costs	10 ³ €	288	5,621	0	1,820,000	735	238
Cost of employees	10 ³ €	174	2,114	0	5,030,00	252	152
Assets	10 ³ €	1,586	53,500	0	21,200,000	3,051	1,423
Number of workers	unit	10	89	1	22,734	13	9
Micro Firms	unit	0.82	0.38	0	1	0.72	0.83
Small Firms	unit	0.15	0.36	0	1	0.2	0.14
Medium Firms	unit	0.02	0.15	0	1	0.06	0.02
Large Firms	unit	0	0.07	0	1	0.01	0.00

Source: Authors' own calculations based on IES.

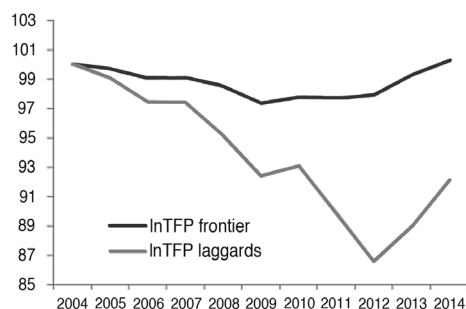


Figure 2: Estimated TFP – non-weighted average across firms (2004=100)

Source: Authors' own computations based on IES.

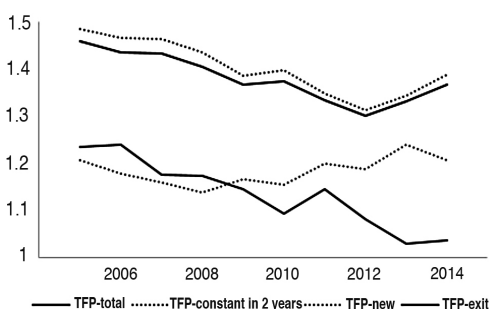


Figure 3: TFP by status of firm: incumbents, new and exit firms

Source: Authors' own computations based on IES.

5. Methods and results

5.1. Intensive margin effects

In this section, we investigate the relationship between increased competition among intermediate goods producers and downstream incumbent firms' performance. Our baseline equation builds on the reduced-form country-industry model in Bourlès *et al.* (2010) and the firm-level application in Arnold *et al.* (2008), both based on the theoretical contributions of Acemoglu *et al.* (2006) and Aghion and Howitt (2006).

We depart from the notion that, in the long-run, the TFP of an individual firm depends both on the TFP of the firms at the sectorial technological frontier and on the regulatory impact of upstream regulation in the sector the firm operates. The identifications rests on the assumption that even if barriers to competition are high upstream, a firm operating in a sector making little use of those inputs should be only marginally affected in comparison with a firm in a more exposed sector. This can be translated into the following Error Correction Model¹³:

$$\begin{aligned} \Delta \ln TFP_{i,k,t} = & \beta_0 + \beta_1 \Delta \ln TFP_{Frontier_{k,t}} + \beta_2 \Delta RegImpact_{k,t} + \delta [\ln TFP_{i,k,t-1} - \\ & \alpha_1 \ln TFP_{Frontier_{k,t-1}} - \alpha_2 RegImpact_{k,t-1}] + \text{Firm controls}_{i,k,t} + \alpha_k + \alpha_t + \\ & \alpha_r + \varepsilon_{i,k,t} \end{aligned} \quad (1)$$

Where $\Delta \ln TFP_{i,k,t}$ is the growth of total factor productivity for firm i in sector k at year t , $\Delta \ln TFP_{Frontier_{k,t}}$ stands for the productivity growth at the sectorial technological frontier (percentile 90 of sectorial productivity) and $RegImpact_{k,t-1}$ measures the impact of regulatory barriers upstream. Additionally, sectoral, time and region fixed effects are included ($\alpha_k, \alpha_t, \alpha_r$, respectively) to control for characteristics that are specific to the sector, year and region. Following the literature firm controls are also included, in particular to control for size differences in terms of number of workers and turnover (OECD, 2014).

By restricting α_1 to unity in equation (1), we can rewrite the expression in terms of the firms' distance to the technological frontier (DTF, defined, at sectorial level, as TFP at the top decile minus TFP of the individual firm):

$$\begin{aligned} \Delta \ln TFP_{i,k,t} = & \beta_0 + \beta_1 \Delta \ln TFP_{Frontier_{k,t}} + \beta_2 \Delta RegImpact_{k,t} + \eta [DTF_{i,k,t-1} + \alpha_2 RegImpact_{k,t-1}] \\ & + \text{Firm controls}_{i,k,t} + \alpha_k + \alpha_t + \alpha_r + \varepsilon_{i,k,t} \end{aligned} \quad (2)$$

In this setting, β_2 gives the effect of regulatory reforms in the short-run while α_2 measures long term effects. In line with the theoretical and empirical literature, α_2 is expected to be negative as firms operating in sectors more affected by upstream regulation are expected to perform worse in relative terms. The sign of β_2 may be positive or negative as short-run effects are, as discussed, ambiguous and depend on different factors. Note that time fixed effects capture the average effect of upstream regulation and therefore our estimates of the regulatory impact coefficient should be read as a differential effect on sectors with different exposures. β_1 and η (defined as $-\delta$) account for the existence of technological diffusion and

catch-up effects and their signs are an empirical question. If β_1 is positive, more productive firms are spreading innovative features across the economy through pass-through mechanisms. A positive η signals a process of catching-up, where those further away from the frontier grow more. While so far the literature usually finds positive diffusion and catch-up effects, more recent *winner takes it all* dynamics may change the sign of the coefficient going forward, calling for particular attention in monitoring the estimated results¹⁴.

Finally, in line with Bourlés *et al.* (2010) on a country-industry setting, our firm-level model is enriched with the interaction between the firm-level distance to the sectorial frontier and the regulatory impact, allowing for an asymmetric effect of regulation across the productivity spectrum:

$$\Delta \ln TFP_{i,k,t} = \beta_0 + \beta_1 \Delta \ln TFP_{Frontier_{k,t}} + \beta_2 \Delta Reg_{impact_{k,t}} + \eta [DTF_{i,k,t-1} + \alpha_2 Reg_{impact_{k,t-1}} + \alpha_3 Reg_{impact_{k,t-1}} \times DTF_{i,k,t-1}] + Firm\ Controls_{i,k,t} + \alpha_k + \alpha_t + \alpha_r + \epsilon_{i,k,t} \quad (3)$$

The long-term impact of regulation upstream is thus given by $\alpha_2 + \alpha_3 DTF_{i,k,t-1}$. As discussed before, the sign of α_3 is an empirical question. If both α_2 and α_3 are negative, then higher competition upstream is more beneficial the further away the firm is from the sectorial frontier. If α_2 is negative and α_3 positive then the benefits of deregulation upstream are decreasing with the relative productivity of the firm.

By estimating equation (3) (Table 4 – column “TFP growth - wide”), we find a positive association between higher growth at the frontier and the growth of other firms, hinting at the existence of positive diffusion mechanisms. The coefficient of DTF is also positive, in line with a process of catching-up of the least productive. This means that innovation at the frontier is spread throughout the economy, with productivity gains for all firms. Moreover, deregulation in upstream sectors is, already in the short-run, positively related with productivity gains in downstream industries more dependent of those input sectors. This result is particularly important, given that some reforms were implemented during crisis years, where costs are more likely, and it is in line with the literature that underscores the still large potential gains to be grasped from more efficient product markets (e.g. Égert *et al.*, 2016a and Barnes *et al.*, 2013)¹⁵.

The positive correlation between deregulation of intermediate goods sectors and the productivity of downstream firms using those inputs is also present in the long-run and increases with the distance to the technological frontier, as in Nicoletti and Scarpetta (2003) and Conway *et al.* (2006)¹⁶. Less productive firms are more likely to be held-up by upstream firms with high market power and therefore deregulation provides for a level playing field, promoting the conditions for these firms to grow. The increased competition downstream (for instance, due to easier entry given the improved access to upstream suppliers and the lower intermediate goods costs) is an added incentive for laggard firms to catch-up with the most productive ones in order to remain competitive. For the highly productive firms (according to the estimated DTF threshold, the 2% most productive), deregulation upstream may induce productivity losses, a result in line with Amable *et al.* (2016). An explanation may be that these firms had sufficient market power to circumvent some of the limitations in upstream

sectors and thus benefited from a competitive edge vis-à-vis the competitors that is eliminated with the reforms. Also, if competition upstream induces higher competition downstream, the compressed mark-ups and increased market uncertainty may be limiting the incentives for the most productive to invest in more disruptive technologies that would allow productivity gains but that entail larger risks during the development process.

The results are robust to a number of robustness tests (Table 4 – columns TFP growth – narrow; LP growth – wide; LP growth – narrow), namely the use of the narrow version of the regulatory indicator and the use of labor productivity instead of TFP.

3.2. Extensive margin effects: the exit channel

The impact of regulation on productivity may be driven by changes at the intensive margin (i.e. changes in the TFP of firms in the market, as assessed in Section 3.1) or at the extensive margin (i.e. the entry and exit of firms)¹⁷. Our hypothesis is that increased competition should foster the exit of the least productive with no growth potential, thus contributing to a more efficient allocation of resources. We formalize this relation in the following equation:

$$\Pr(Exit_{i,k,t}) = \beta_0 + \beta_1 \text{RegImpact}_{k,t-1} * \ln TFP_{i,k,t-1} + \beta_2 \text{RegImpact}_{k,t-1} + \beta_3 \ln TFP_{i,k,t-1} + \text{Firm Controls}_{i,k,t} + \varepsilon_{i,k,t} \quad (4)$$

Where $Exit_{i,k,t}$ is equal to 1 when a firm exits the market and 0 otherwise, $TFP_{i,k,t-1}$ stands for the firm level of productivity and $\text{RegImpact}_{i,k,t-1}$ is defined as in (1). Less productive firms are expected to be more likely to exit and increased competition should foster exit for all firms. Moreover, in sectors more exposed to deregulated upstream sectors, we expect a higher differential in the exit probabilities of firms with different levels of productivity, with the worst firms being more likely to exit.

Table 3
PRODUCTIVITY AND UPSTREAM REGULATION – RESULTS OF THE ESTIMATION OF EQUATION [3]

	TFP growth - wide	TFP growth - narrow	LP growth - wide	LP growth - narrow
TFP growth frontier	0.38	0.34	0.23	0.22
	0.00	0.00	0.00	0.00
DTF (lag)	0.69	0.57	0.58	0.51
	0.00	0.00	0.00	0.00
RegImpact (lag)				
Short-term	-0.12	-0.30	-0.13	-0.19
	0.00	0.03	0.00	0.00
Long-term	-0.32	-1.46	-0.77	-1.16

(Continued)

	TFP growth - wide	TFP growth - narrow	LP growth - wide	LP growth - narrow
	0.00	0.00	0.00	0.00
Long-term #DTF	-1.13	-0.56	-0.88	-0.88
	0.00	0.00	0.00	0.00
Firm size effects	yes	yes	yes	yes
Region effects	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
Sectorial effects	yes	yes	yes	yes
N	1,522,076	1,522,076	1,669,162	1,669,162

Source: Authors' own computations using IES and OECD data. Notes: All equations are estimated by maximum likelihood. The first line reports the estimated coefficients and the second the associated P-value. Standard errors for the long-term coefficients were obtained using the delta method in STATA. Errors are cluster at sectorial level.

Given that the variables in equation (4) are continuous, the results are better captured graphically. Figure 5A, displays the marginal effect of changes in productivity with the regulatory variable set at its maximum and minimum (i.e. 1 and 0); Figure 5B varies regulation, for two given values of productivity (one very high and one very low). Panel A illustrates that the lower the level of productivity, the higher the impact of exposure to regulated sectors on the relative exit probability. Similarly, by comparing two firms with different productivity levels, Panel B again shows that the difference between their relative exit probabilities is higher in less rigid upstream regulatory environments.

In other words, increased competition fosters the exit of all firms (in comparison to firms in sectors not exposed to the deregulated sectors), but more so for the least productive. This result complements the literature on the positive impact of competition on churn rates (Lanau and Topalova, 2016, Gal and Hijzen, 2016), by highlighting the improvements in the efficiency of the exit channel. While Section 3.1. shows that catch-up is potentiated by competition, here we highlight that firms that are not able to become more productive are more likely to exit the market. The result is robust to alternative specifications, namely the use of the narrow version of the regulatory indicator and the use of labour productivity as the dependent variable, instead of TFP.

3.3. Resilience effects

The analysis in the previous sections hints at an important selection effect of competition. While increased competition upstream is particularly beneficial for the laggard firms with potential to catch-up with the frontier (Section 3.1), the non-viable laggards face a higher likelihood of exiting (Section 3.2). This positive selection is likely to render downstream markets more resilient to adverse shocks.

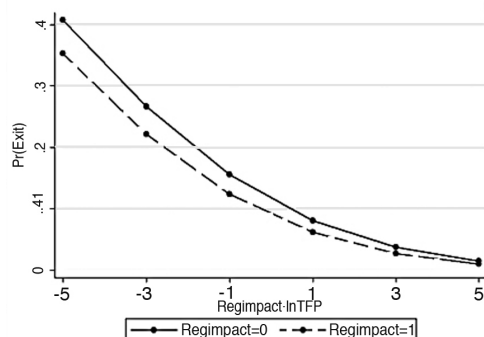


Figure 4a: Exit model: predictive Margins (fixing the Regulatory Impact indicator)

Source: Authors' own computations using IES and OECD data.

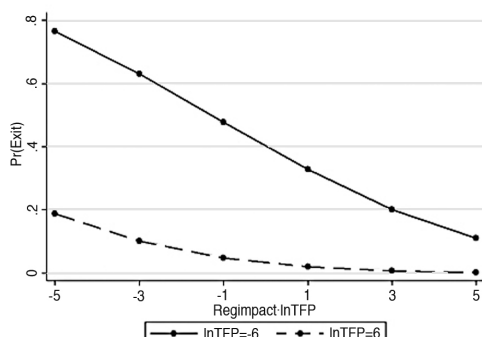


Figure 4b: Exit model: predictive Margins (fixing productivity level)

Source: Authors' own computations using IES and OECD data. Note: The levels of productivity are hypothetical and should be seen as extreme values. The gains displayed are illustrative and should be read as upper bounds.

Building on the literature on the positive effects of increased competition on market resilience, we apply a *differences-in-differences* approach to evaluate whether firms in sectors more exposed to the reformed upstream sectors (*treated* group) are more resilient to adverse shocks. We expect their productivity levels to be less affected by the 2011 crisis, as compared to the *control* group (i.e. to firms less exposed to the reformed sectors).

Given that, up to 2011, the most important reforms tackled the network sectors, we focus on exposure to network inputs. Moreover, within networks, there is one sector that stands out: the gas sector (Figure 6). Reforms entailed a significant reduction of public ownership, the reduction of entry barriers, the possibility of third party access to the gas transmission grid and the ability of consumers to freely choose their gas suppliers.

Therefore, we rely on the usage of gas inputs to measure exposure and create the *treated* and *control* groups. The sectors included in the *treated* group (i.e. those above the percentile 70) are Electricity, gas and water supply; Other non-metallic mineral products; Mining and quarrying; Basic metals; Hotels and Restaurants; Agriculture, hunting, forestry and fishing; Pulp, paper, paper products, printing and publishing and Rubber and plastics products. Those in the control group (i.e. below percentile 30) are Post and telecommunications; Electrical machinery and apparatus, nec; R&D and other business activities; Construction; Motor vehicles, trailers and semi-trailers; Computer, Electronic and optical equipment; Renting of machinery and equipment and Coke, refined petroleum products and nuclear fuel.

As the data source for inputs usage - the OECD sectorial input-output matrices - does not provide separate data for the gas sector, we take the values for *gas, electricity and water*

supply usage. This is not problematic as electricity is also one of the most reformed sectors, with reductions in the public ownership and improvements in the market structure.

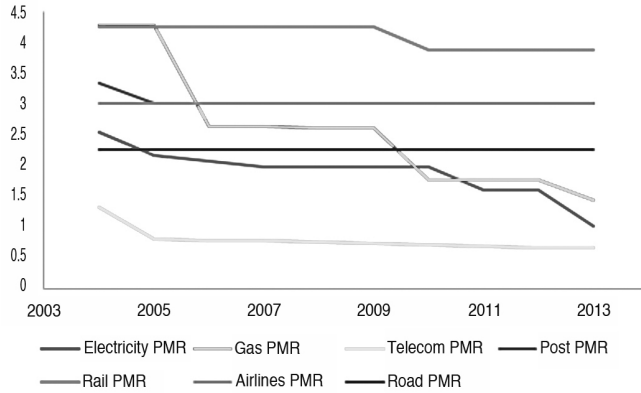


Figure 5: Product market regulation in network industries in Portugal

Source: OECD, Product Market Regulation Database.

Notes: Sectorial indicators vary between 0 and 6, increasing in the stringency of regulation.

The *treated* and *control* sectors have, by construction, very different intensities of electricity, gas and water inputs usage: between 4% and 54% of total inputs for the *treated* group (corresponding to the top tercile) and from 0% to 1% for the *control* group (bottom tercile). In addition to these differences, Table 4 shows that firms in *treated* sectors are more productive but are also smaller, both in terms of number of employees and output. Operational costs and the cost of employees are higher in the *control* group.

The binned scatterplot in Figure 6 allows for a visual representation of our data. It presents, for each year, the mean productivity across firms within the *treated* and *control* groups, respectively. The chart shows that firms in the *treated* group are on average more productive than those in the *control* group and that the crisis negatively impacts both groups. However, it is also visible that the *treated* group is less affected, with a lower decline in the average productivity level. These results can be replicated with the following *difference-in-differences* specification:

$$\ln TFP_{i,k,t} = \alpha_0 + \alpha_1 T_k + \alpha_2 S_t + \alpha_3 T_k * S_t + FirmControls_{i,k,t} + \varepsilon_{i,k,t} \quad (5)$$

The dependent variable is the log of total factor productivity of firm I , in sector k and year t ; T_k is the treatment dummy, i.e., i_t indicates firms in *treated* sectors; S_t is a time dummy that turns one from 2011 onwards, while $T_k * S_t$ is the *differences-in-differences* term. Based on Figure 6, we expect α_1 to be positive and α_2 to be negative. Moreover, if our hypothesis that reforms render firms more resilient is confirmed, we also expect α_3 , the coefficient of the interaction term, to be positive (but lower than α_1).

The results in Table 5 confirm these expectations. In particular, while all firms face the adverse effect of the crisis, those in sectors more exposed to the reformed sectors are less affected and therefore have a lower decrease in TFP as compared to firms in the control group. The increased resilience is a result found by other authors (e.g. Cacciatori and Fiori, 2016; Duval *et al.*, 2007; Ernst *et al.*, 2007; Pelkmans *et al.*, 2008) and in this paper we shed light on the possible mechanism for this result. The intensive margin channel (Section 3.1) is allowing viable firms to catch-up with the frontier and therefore become larger. The extensive margin channel is fostering the exit of the least productive with no ability to catch-up and strive (Section 3.2). The growth of good firms and the survival of the fittest renders firms operating in the market more resilient, via a process of positive selection. Moreover, in times of crisis, increased competition among intermediate goods producers means that downstream firms are not held-up by excessive market power upstream, which would force them to absorb a large share of the crisis imposed losses.

Ideally, we should have a placebo group, running the same DiD in a period with a crisis but no deregulation policies. However, this is not possible, as our dataset only covers the period starting in 2004. In any case, we perform two robustness checks based on the available data. First, we compute the same regression without the electricity and gas sectors. These sectors could potentially bias our results, as they are directly affected by the reforms (on top of the usual downstream effects affecting all sectors). The results remain unchanged, as we continue to see more resilience in the treated group (Table 5). In addition, using LP instead of TFP also keeps the results qualitatively unchanged.

Table 4
DESCRIPTIVE STATISTICS – FIRM LEVEL DATA - DID ESTIMATION

Variable	Unit	Treated	Control	t ^a
Output	10 ³ €	1,120 (28)	1,289 (70)	-2.48
Operational Costs	10 ³ €	164 (3)	434 (10)	-32.81
Cost of Employees	10 ³ €	118 (2)	195 (4)	-21.18
Assets	10 ³ €	1,622 (81)	1,762 (48)	-1.13
lnTFP	unit	2 (0)	1 (0)	200
Number of workers	unit	8 (0.11)	11 (0.14)	-16.09

Source: Authors' own calculations based on IES.

Note: Test of equality of means in treated and control groups.

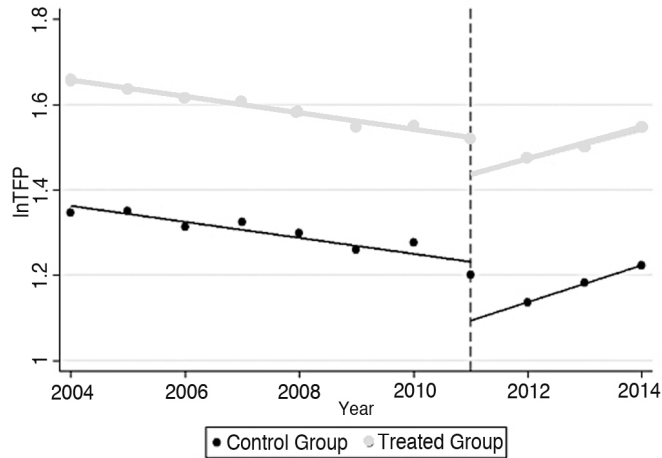


Figure 6: Mean TFP levels for treated and control groups

Source: Author's own calculations using IES data. $N = 1,373,056$.

Note: The graph was produced using the Binscatter command in Stata, imposing a discontinuity in 2011.

Table 5
RESILIENCE MODEL: RESULTS OF THE ESTIMATION OF EQUATION [5]

	All sectors - lnTFP	Excluding electricity and gas sectors - lnTFP	All sectors - lnTFP	t ^a
Time	-0.12*** 0.00	-0.12*** 0.00	-0.29*** 0.01	-2.48
Treated	0.29** 0.11	0.29** 0.11	0.12 0.20	-32.81
DiD	0.04** 0.01	0.03** 0.01	0.11*** 0.02	-21.18
Cons	1.31*** 0.01	1.31*** 0.01	0.11*** 0.02	-1.13
Firm level controls	YES	YES	YES	200
N	1,373,056	1,369,516	1,490,905	
R2	0.03	0.03 (0.11)	0.01 (0.14)	-16.09

Source: Authors' own computations. For each explanatory variable, the first line present the estimated coefficient and the second the standard error (adjusted for clusters at sectorial level). * $p < .10$, ** $p < .05$, *** $p < .01$.

6. Conclusion and way forward

Deregulation of upstream sectors features highly in the structural reform agenda of many countries, and it is widely advocated by all major international institutions. For instance, in 2017, close to two-thirds of the countries reviewed by the OECD in its flagship publication *Going for Growth* have upstream sector reforms as a key priority area. In the same vein, in the 2017 *Annual Growth Survey*, the document outlining the general economic priorities for the EU, the European Commission stresses the benefits of more competitive product markets: “opening up business services to more competition would benefit the EU economy as a whole”, “competitive retail services should allow consumers to grasp more benefits from digitisation, more efficient value chains, increased choice and lower prices” and “the further reduction of restrictions in the services markets would improve productivity and competitiveness and lead to job creation”.

While exiting literature indeed points to the benefits for the economy at large of improved upstream regulation, there are a number of open empirical questions that we address in our contribution.

The first relates to the short-term impact of reforms. In particular, while economic crisis are good opportunities to push for reforms, as structural weaknesses become clearer, downturns also make related short-term costs more likely, for instance because firm exit is not promptly compensated by new entrants¹⁸. By focusing on a top product market reformer among OECD countries, where several reforms were implemented during a severe economic crisis, we show that the benefits are sufficiently large to ensure that the deregulation of intermediate goods providers is beneficial for the average firm, already in the short-run. This is particularly relevant for the sustainability of the reform process, as costs, even if temporary, erode the support for the reform agenda and may not only hamper future reform efforts but also reverse some of the past efforts.

The second contribution relates to the impact of reforms across the productivity distribution. We find a stronger relation between deregulation upstream and productivity for firms further away from the sectorial technological frontier. Our intuition for this result is that market power upstream is particularly damaging for laggard firms, which are more likely to be held-up by upstream firms. The removal of this inefficiency, coupled with increased competition downstream as a result of increased competition upstream (as, for instance, entry downstream becomes easier, given the enhanced access to intermediate goods producers) boost incentives for laggard firm to catch-up and remain competitive. At the same time, the increased competition drives the least productive with no growth opportunities out of the market, promoting a more efficient allocation of resources and reducing market congestion. For the top performers within each sector, increased competition upstream acts as a level playing field vis-à-vis laggard competitors. Moreover, the reduced mark-ups and the increased market uncertainty reduces the incentives to engage in disruptive innovation, crucial in sustaining productivity gains for already top performing firms, but also riskier in terms of expected returns.

These results show that upstream reforms have broad-based benefits, providing an opportunity for viable firms to catch-up with the sectorial frontier. This is particularly relevant in a context where the emergence of new business models and of *winner takes it all* dynamics reduce the ability for laggard firms to remain competitive and potentiate increased market concentration¹⁹. At the same time, our results have two downsides that warrant targeted policy action. The first is the discouraging effects for the top performers that can be tackled with measures such as strong intellectual property rights (Aghion *et al.* 2015), thereby ensuring that the incentives to expand the technological frontier, in particular via disruptive innovation, remain. The second relates to the positive selection of the most productive, which, while improving productivity and efficiency, may have an adverse impact on segments of the labor market and on inequality. Measures to improve on skill mismatches and effective active labor market policies are therefore important complements to upstream deregulation (Andrews and Saia, 2017 and OECD, 2015).

Finally, we argue that the improved catching-up of laggards firms, allowing them to grow, and the survival of the fittest concur for firms' improved resilience to adverse shocks. In addition, limiting the market power of intermediate goods producers makes it more difficult for them to pass-on the crisis induced costs to downstream companies. By comparing firms more and less exposed to the sectors reformed before the economic crisis, we indeed find evidence that more exposed firms were better able to weather the negative effect of the crisis, with a smaller decline in productivity. This additional benefit is less studied than the impact on the intensive and extensive margins but it is an important one. It ensures that firms are less affected by adverse shocks, contributing to the reduction of the amplitude of the downturn and to a quicker recovery, also reducing the possible hysteresis effects.

Overall, our results fit into a large body of literature shedding light on the direct and indirect impact of removing excessive regulation in upstream sectors. A more effective communication of these results, beyond academic circles, would potentiate ownership and provide the necessary support for reforms, key elements of any successful and sustained reform process²⁰. This is true for all reform areas but it is even more relevant in the case of upstream deregulation, where vested interests are particularly acute, given the concentrated costs and the diffuse benefits. As noted by the President of the European Central Bank, Mario Draghi, "during the crisis, because of powerful vested interests, labour market reforms were not accompanied by product market reforms in some countries, and so wages fell and prices did not adjust in tandem"²¹. While EU directives have been playing a critical role in pushing forward deregulation of upstream sectors at national level (Banerji *et al.*, 2017), a more informed discussion would also facilitate targeted action to deal with the costs induced on those with vested interests, namely by enacting transitory measures that allow for a smoother transition²².

Going forward, the robustness of our econometric results need to be further validated, in particular concerning causality. As noted by Boursès *et al.* (2013), omitted variable bias may be present, with the estimates possibly capturing changes in these other variables. As upstream deregulation was accompanied by other important reform efforts, reform variables in

different areas are strongly correlated. Therefore, our coefficients may be overestimating the impact of upstream deregulation, by capturing other reform efforts that occurred at the same time and that concur for improved productivity. Additional efforts are needed to model reform complementarities and the impact of the countries initial regulatory stance. Moreover, one could argue that reforms are endogenous, as sectors with higher expected pay-offs lobby more strongly for reforms. In the case of Portugal, this is somewhat mitigated, as several reforms were part of the Economic Adjustment Programme negotiated with the European Commission, the European Central Bank and the International Monetary Fund.

The underlying data could also be further enhanced. On the regulation indicators, a better identification of the timing of the reform could enhance the quality of the results. Moreover, *de jure* measures of competition may not adequately capture the actual effects of legislative changes, which can be hampered by administrative capacity limitations. In any case, *de facto* measures of competition also present important drawbacks, as they are endogenous outcomes. The firm level variables could also be further enhanced, in particular concerning the computation of total factor productivity, which is dependent not only on the measures of capital and labor but also on the underlying production function and on the econometric techniques applied in its estimation. While our results are robust to the use of labor productivity (which encompasses total factor productivity and capital deepening) as the dependent variable, alternative measures could be explored.

Finally, the mechanisms through which the reforms operate need to be further investigated, shedding light on the links between upstream and downstream developments. Furthermore, as stressed by Pelkmans and Renda (2014), regulation is a broad concept and not all regulation is harmful. A deeper look into the differentiated effects across the different types of regulations is warranted. In addition, while total factor productivity is a key determinant of growth, a full assessment of the reforms' impact can only be done by also considering the impact on investment and labour utilisation, in particular on employment²³. An encompassing view of the literature is thus essential to fully ascertain the impact of reforms. Equity considerations need to take a more central stage, as the distributional effects of reforms have been less studied so far, also due to the demanding data requirements (worker or household level data).

Table A1
REGULATORY IMPACT INDICATOR – BY SECTOR AND YEAR - WIDE VERSION

(Continued)

Table A1
REGULATORY IMPACT INDICATOR – BY SECTOR AND YEAR - WIDE VERSION

Variable	Unit	Treat- ed	Con- trol	t ^a					
Pulp, paper, paper products, printing and publishing	0,11	0,11	0,10	0,10	0,11	0,11	0,10	0,10	0,08
Radio, television and communication equipment	0,12	0,12	0,12	0,12	0,13	0,13	0,13	0,13	0,09
Real estate activities	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,02
Renting of machinery and equipment	0,08	0,08	0,08	0,08	0,09	0,09	0,09	0,09	0,06
Research and development	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,05
Rubber and plastic products	0,14	0,14	0,13	0,13	0,14	0,14	0,14	0,14	0,10
Textiles, textiles products, leather and footwear	0,10	0,10	0,09	0,09	0,10	0,10	0,10	0,10	0,07
Transport and storage	0,39	0,39	0,39	0,39	0,40	0,40	0,38	0,38	0,36
Wholesale and retail trade; repairs	0,37	0,37	0,37	0,37	0,43	0,43	0,43	0,43	0,23
Wood and products of wood and cork	0,11	0,11	0,10	0,10	0,11	0,11	0,11	0,11	0,08

Source: OECD.

Notes

1. For studies focusing on the direct effects of upstream deregulation on upstream sectors, please refer for instance to Gal and Hijzen (2016) and Lanau and Topalova (2016).
2. We refer to a healthy level of competition given that, as noted by Aghion *et al.* (2005), excessive deregulation can also be detrimental. The effects of competition on productivity are therefore hump-shaped, as explained by the authors: "The essence of the inverted-U relationship between competition and innovation is that the fraction of sectors with neck-and-neck competitors is itself endogenous, and depends upon equilibrium innovation intensities in the different types of sectors. More specifically, when competition is low, a larger equilibrium fraction of sectors involve neck-and-neck competing incumbents, so that overall the escape-competition effect is more likely to dominate the Schumpeterian effect. On the other hand, when competition is high, the Schumpeterian effect is more likely to dominate, because a larger fraction of sectors in equilibrium have innovation being performed by laggard firms with low initial profits". At one extreme, if competition is so low that there exists only one firm, there are no incentives to innovate. At the other extreme, if competition is so strong that firms cannot absorb any rents from innovation, then productivity is negatively affected.
3. For instance, Gal and Hijzen (2016) show that, while the effect of reforms is always positive for downstream sectors, it is more visible for manufacturers, which operate in a sector that is, in general, more competitive (and thus have more to gain in terms of increase output from potential price reductions made possible for lower priced inputs). By further exploring the direct effects on the reformed upstream sectors, the authors argue that higher initial regulation may bring higher short-term costs but also larger long-term gains.
4. From the different reform areas, product market reforms are expected to produce the largest economic gains when compared to other reforms (see, for instance, Égert and Gal, 2016 and Barnes *et al.*, 2013).
5. See Koske *et al.* (2014) for further details on the indicators.
6. See Égert and Wanner (2016) for more information. Earlier applications of this methodology can be found for instance in Conway and Nicoletti (2006).
7. For a discussion on the pros and cons of using the wide and narrow indicators, see Égert and Wanner (2016).
8. For more details, see Supplement to Banco de Portugal Statistical Bulletin 11/2008 "Simplified reporting: Inclusion of the Simplified Corporate Information in the Statistics on Non-Financial Corporations from the Central Balance Sheet Database of May 2008".
9. We rely on the STATA code developed by Petrin *et al.* (2004).
10. Please refer to Petrin *et al.* (2004) for additional details.
11. The included sectors are Agriculture, hunting, forestry and fishing; Mining and quarrying; Food products, beverages and tobacco; Wood and products of wood and cork; Pulp, paper, paper products, printing and publishing; Coke, refined petroleum products and nuclear fuel; Chemicals and chemical products; Rubber and plastics products; Other non-metallic mineral products; Textiles, textile products, leather and footwear; Basic Metals; Fabricated metal products except machinery and equipment; Machinery and equipment n.e.c; Motor vehicles, trailers and semi-trailers; Other transport equipment; Electricity, gas and water supply; Construction; Transport and storage; Post and telecommunications; Real estate activities; Office, accounting and computing machinery; Electrical machinery and apparatus n.e.c; Radio, television and communication equipment; Medical, precision and optical instruments; Manufacturing n.e.c and recycling; Wholesale and retail trade, repairs; Hotels & Restaurants; Renting of machinery and equipment; Computer and related activities; Other Business Activities; Research and Development. Note that deregulated sectors are also included as they also use intermediate goods in their production process.
12. This division includes 7 regions, covering Mainland Portugal and Islands.
13. For the statistical properties of Error Correction Models, please refer to Hendry (1996).
14. See, for instance, Autor *et al.* (2017).
15. It also means that, absent the crisis, the short-term effects would have been stronger.

16. In other words, the process of catching-up is limited by lack of competition upstream and may actually be hampered for very high levels of upstream regulation (higher than the maximum of our time series).
17. In our analysis, we focus on the exit margin but, ideally, one would like to also explore the entry channel. However, an assessment of entry at the firm-level is particularly challenging as it requires data on the pool of entrants and not only on those firms that actually entered the market.
18. Dias da Silva *et al.* (2017) show that the implementation of structural reforms is more likely during deep recessions.
19. In the 2017 Annual Growth Survey, the European Commission notes that “particular attention needs to be given to the diffusion of new technologies among small and medium-sized companies. Their difficulties in taking up new technologies and gaining access to fresh capital are more acute in a globalised, technology-driven economy”.
20. The literature shows that information is crucial to boost support for reforms (Boeri and Tabellini, 2012; Gouveia, 2017).
21. Introductory remarks by Mario Draghi, President of the ECB, at the ECB conference “Structural reforms in the euro area”, Frankfurt am Main, 18 October 2017.
22. As noted by Banerji *et al.* (2017), past reforms “were incentivized by grandfathering—for example, during the liberalization of professional services in the Netherlands there was a two-year transition period for public notaries”.
23. Existing evidence points to positive effects on employment, that strengthen over time (OECD, 2016; Fiori *et al.*, 2012), as higher competition upstream decreases downstream input prices and eliminates the market-power of upstream sectors vis-à-vis downstream firms, reducing their ability to partially capture downstream rents (Bourlès *et al.*, 2010). Bassanini (2015) shows that employment in upstream sectors is temporarily reduced, via downsizing of incumbents.

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Resumen

A partir de un rico conjunto de datos a nivel de empresa para uno de los países de la OCDE que mayor número de reformas ha realizado durante la última década, encontramos una asociación positiva, en el corto plazo, entre la productividad de la empresa y la desregulación de los sectores de productos intermedios. Los efectos a largo plazo dependen de la productividad de la empresa, aumentando las ganancias con la distancia a la frontera de posibilidades de producción tecnológica sectorial (nacional). Es más probable que las empresas menos eficientes sean rehenes de los productores con mayor poder de mercado en las fases anteriores de la cadena de producción, por lo que su potencial de mejora es mayor que el de las empresas más productivas. Estas empresas se encuentran mejor preparadas para hacer frente a las ineficiencias de los mercados de productos intermedios de las fases anteriores del proceso productivo. Los resultados indican que las empresas más productivas reducen sus incentivos para innovar como consecuencia de la reducción de su ventaja competitiva, de la disminución de los márgenes de beneficio y del aumento de la incertidumbre. Encontramos indicios de la existencia de una selección positiva entre las empresas menos eficientes: en el caso de las empresas viables las reformas aumentan su potencial de crecimiento y les permiten ponerse al día. En las empresas que no son viables aumenta la probabilidad de quiebra ya que no son capaces de competir en un entorno más exigente. De hecho, mientras que el aumento de la competencia en las fases finales del proceso productivo (como resultado del aumento de la competencia en fases anteriores del proceso productivo) está asociado a mayores probabilidades de quiebra para todo tipo de empresas, los resultados muestran una asociación más fuerte para las empresas con menor productividad. Por último, cuando comparamos los resultados de las empresas más y menos expuestas a las reformas anteriores a la crisis, observamos que la supervivencia de las más productivas y el crecimiento de las rezagadas pero viables aumenta la resistencia de las empresas que operan en el mercado.

Palabras clave: reformas estructurales, mercados de productos, productividad.

Clasificación JEL: D04, D22, L43, L51

